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**HILGER
CATALOGUE**

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**MONOCHROMATORS
AND
SPECTROMETERS**

**JUNE
1939**

ADAM HILGER LTD., OPTICAL INSTRUMENT MAKERS
98 ST. PANCRAS WAY, CAMDEN ROAD, LONDON, N.W. 1., ENGLAND

**PRICES SUBJECT TO AN INCREASE OF
APPROXIMATELY 10%**

Liabile to alteration without notice.

Orders are executed at lowest prices current at time of delivery, but so far as possible firm prices will be quoted on receipt of order.

**Revisions to Catalogue
The Barfit Wavelength Spectrometer
(S.B. 241/2)**

Pages 14, 15, 16.

In place of the instruments D 186 and D 187 we now offer D 231 and D 232 which are similar except that they do not include a cover to the prism table, and in place of the shutter eyepiece formerly included they have an eyepiece with cross webs with zero adjustment.

The Revised Prices are :

D 231.—Hilger Constant Deviation Wavelength Spectrometer with prism of nD 1.65 ...	£79 10 0
D 232.—Hilger Constant Deviation Wavelength Spectrometer with prism of nD 1.74 ...	79 10 0
D 220.—Cover to prism table, extra ...	0 18 0
F 731.—Shutter Eyepiece, extra ...	9 15 0

The following additions to the recommended groups of accessories should be made. When the items referred to have already been ordered with another group of accessories they need not, of course, be duplicated.

Group I, pages 17, 18.

Add : D 220 Cover to prism table ... £0 18 0

Group II, pages 21 to 23.

Add : D 220.—Cover to prism table ... 0 18 0

Group III, pages 25-27.

Add :

D 220.—Cover to prism table ...	0 18 0
F 731.—Shutter Eyepiece ...	9 15 0

Group IVa, pages 28-29.

Add : D 220.—Cover to prism table ... 0 18 0

Group V, page 32.

Add :

D 220.—Cover to prism table ...	0 18 0
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Group VIIa, pages 39-40.

Add : D 220.—Cover to prism table ... 0 18 0

[OVER

Group VIII, pages 40-44, and Group IX, pages 44-46.			
D 220.—Cover to prism table	...	...	£0 18 0
Group X, pages 49-51			
Add :			
D 220.—Cover to prism table	...	...	0 18 0
Spare Parts :			
D 217.—Telescope is now supplied without any eyepiece	...	...	19 5 0
F 731.—Shutter Eyepiece with light filters	...	...	9 15 0
F 517.—Eyepiece with cross webs, fitted with Ramsden eyepiece ($\frac{3}{4}$ in.)	...	...	2 15 0
Note. Group VIIb.			
F 977.—Aluminised Concave Mirror on Barfit Stand is unsuitable for use with the Double Monochromator.			
Substitute :			
F 976.—Aluminised Mirror as F 977 but on Tripod Base	8 12 0

November 1939

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ADAM HILGER LTD.
LONDON, ENGLAND

CATALOGUE D

MONOCHROMATORS, WAVELENGTH SPECTROMETERS, AND SPECIALISED SPECTROSCOPES

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For spectroscopic accessories see Catalogue F.

The Optical Work of our Spectrometers and Spectrographs is controlled by the use in our workshops and testing rooms of the Hilger Interferometers mentioned in Catalogue N.

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A

June, 1939.

MONOCHROMATORS FOR THE ULTRA-VIOLET, VISIBLE AND INFRA-RED

THE MÜLLER-HILGER UVISIR
(ULTRA-VIOLET—VISIBLE—INFRA-RED)
DOUBLE SPECTROMETER-MONOCHROMATORS
(British Patents Nos. 300786, 344722 and 363264 and 374429)

For full particulars see Hilger publication No. 169

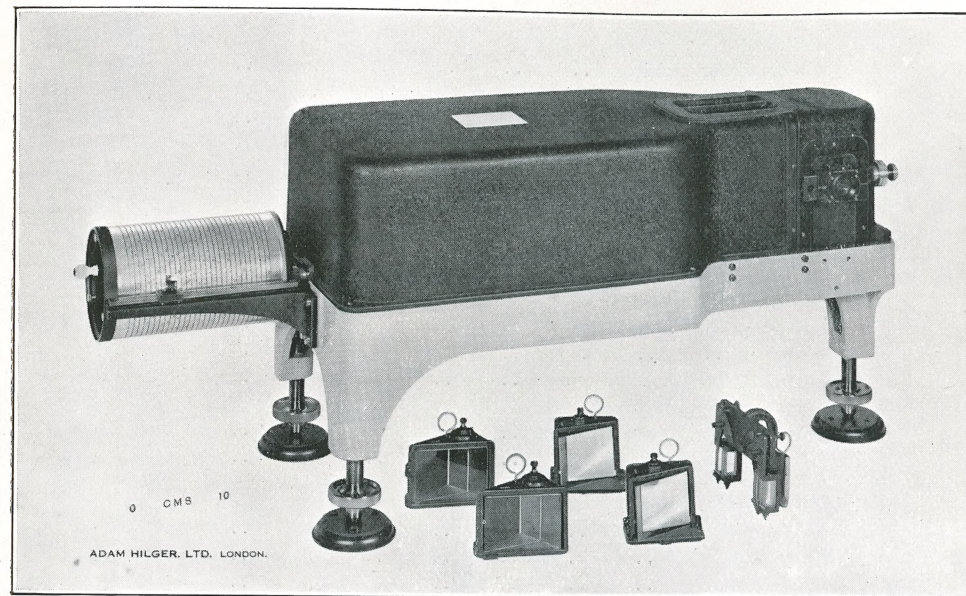


Fig. D 121-124-125-133-134

MÜLLER-HILGER DOUBLE MONOCHROMATOR AND INTERCHANGEABLE OPTICAL WORK

It is essential in some fields of work that monochromatic light of a high degree of purity is employed, and as apparatus of the type of a single ordinary spectrometer, on account of its inherent defects with respect to stray light, does not provide monochromatic light of the requisite purity, it has become usual to pass the light through a second dispersing and purifying system. In the Müller-Hilger Uvisir Spectrometer-Monochromator the principle of double purification is applied in a Double Monochromator of novel form and rigid construction, in which one adjustment, effected by a single wavelength drum and simple mechanism, suffices for both wavelength change and lens focussing simultaneously.

In addition to its function as a monochromator the instrument is also an efficient large-aperture spectrometer for the ultra-violet, infra-red and visible spectrum.

INTERCHANGEABLE OPTICAL SYSTEMS

Four optical systems using different materials are available and interchangeable upon these instruments:

- (1) Crystalline Quartz with a calibration range between 0.185μ and 4.0μ .
- (2) Rocksalt with a calibration range between 0.24μ and 17μ .
- (3) Sylvine with a calibration range between 0.21μ and 22.5μ .
- (4) Glass with a calibration range between 0.36μ and 2.0μ .

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The above calibration ranges may extend slightly beyond the actual transmission for any given set of optical work.

Interchangeable adjusting drums reading directly in wavelengths can be supplied for each optical system. Alternatively the instrument can be fitted with a drum calibrated in refractive indices and therefore of use with all the systems.

DESCRIPTION OF OPTICAL SYSTEM

APERTURE, 60 MM. FOCAL LENGTH, 300 MM. FOR 0.5461μ .

The following is a brief outline of the construction of the optical systems. Detailed particulars will be found in Hilger Publication No. 169 (gratis on request).

The instrument employs two Young prism-trains side by side, the second prisms of each train being back-reflecting. They are mounted upon the same rotating prism table mounted upon a sliding carriage, acted upon by the automatic adjustments referred to above. The first prism of each train has an aspherical surface corrected on the Hilger interferometer, worked upon its front face. This forms the objective for each half of the instrument, thus eliminating loss of light by reflection at intermediate lens and prism surfaces. Light proceeds to and from the objective prisms and is directed respectively from and to the entrance and exit slits of each half of the instrument by totally reflecting prisms. The intermediate slit is common to both halves of the monochromator. All slits are of course stationary, the necessary adjustment for wavelength being made merely by adjustment of the wavelength drum.

The emergent beam is in constant focus upon the exit slit. The entrance and exit slits are appropriately curved to correspond to the straight intermediate slit. The exit slit is constructed to carry a thermopile.

The back surfaces of the second dispersing prisms are coated with a highly reflecting metallic deposit by an improved aluminising process.

The optical work of glass, D 133, includes mounted slit prisms as with other materials; but if optical work of quartz is available these are not required. Glass set D 230 should then be used.

Each set of optical work is supplied in a case with space for the wavelength drum.

D 121.—Müller-Hilger Uvisir Spectrometer-Monochromator Basic Instrument without optical system or adjusting drum.

D 122.—Refractive Index Drum, for D 121.

D 124.—Quartz Optical Work and mounts, for D 121.

D 125.—Wavelength Drum for Quartz, for D 124.

D 127.—Rocksalt Optical Work and mounts, for D 121.

D 128.—Wavelength Drum for Rocksalt, for D 127.

D 130.—Sylvine Optical Work and mounts, for D 121.

D 131.—Wavelength Drum for Sylvine, for D 130.

D 133.—Glass Optical Work and mounts, for D 121.

D 230.—Glass Optical Work and mounts, for D 121, without mounted slit prisms.

D 134.—Wavelength Drum, for glass, for D 133 on D 230.

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CONDENSING LENS ATTACHMENTS FOR MÜLLER-HILGER UVISIR SPECTROMETER-MONOCROMATORS

A series of condensing lens attachments, specially designed for securing the greatest efficiency in the use of these instruments, has been designed. For full descriptions see Hilger Publication No. 169.

CONDENSER LENS ATTACHMENTS FOR LARGE MODEL

D 161.—Condensing Lens Travelling Mount Attachment, to D 121 (without lenses).

D 176.—Quartz Spherical Condensing and Field Lenses, for D 124 and D 161 (unfigured).

D 177.—Glass Spherical Condensing and Field Lenses, for D 133 and D 161 (unfigured).

D 162.—Figured Quartz Spherical Condensing Lens and Field Lens, for D 124 and D 161.

D 193.—Figured Glass Spherical Condensing Lens and Field Lens, for D 133 and D 161.

LARGE QUARTZ WAVELENGTH SPECTROMETER and MONOCHROMATIC ILLUMINATOR for the ULTRA-VIOLET and VISIBLE READING FROM 1850 Å TO 9000 Å DIRECT IN WAVELENGTHS

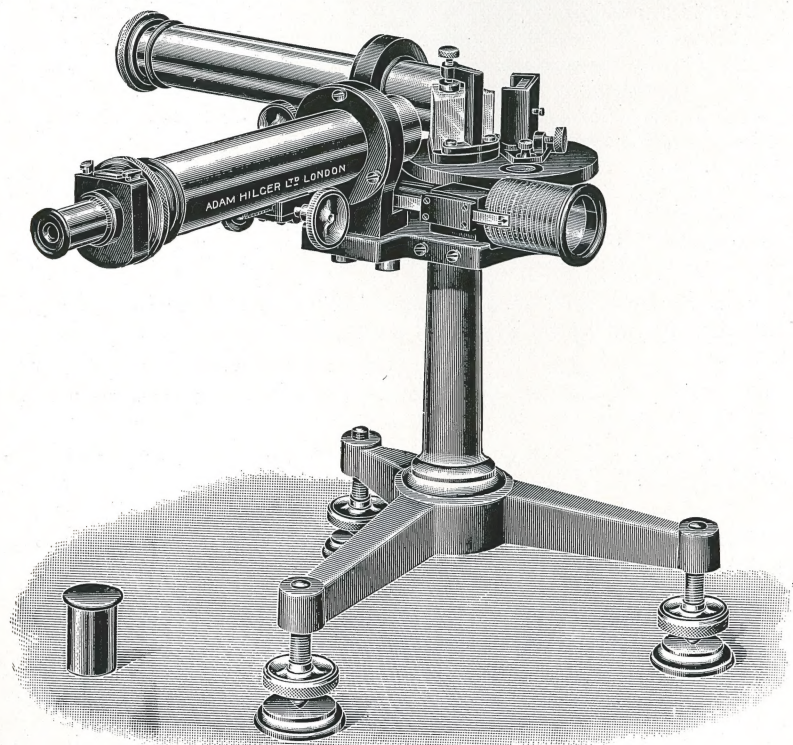


Fig. D 41

This instrument is generally similar to the above illustration.

Levelling screws are always supplied.

The lenses are of 22 cms. focal length for $\lambda = 3000 \text{ Å}$, aperture 49 mm., relative aperture of F/4.5. The lenses are figured by the Hilger interferometers (see Catalogue N), for the removal of spherical aberration.

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The beam of light from the collimator passes at minimum deviation through a Cornu prism of quartz (height 45 mm., length of face 74 mm.), and is then reflected from a plane mirror into the telescope. The mirror consists of a plane parallel plate of quartz coated on the back with mercury tinfoil amalgam, which is an excellent reflector in the ultra-violet. The prism and mirror stand on one table, which is rotated by means of a fine steel screw in the same way as the prism table of the wavelength spectrometer, the wavelength of the portion of the spectrum under observation being read off direct on a helical drum.* The average accuracy of reading throughout the range is about 3 Å. The collimator and telescope are rigidly fixed to the cast-iron base and are each provided with a scale, engraved in wavelengths, for setting the focus of the lenses for the part of the spectrum under observation.

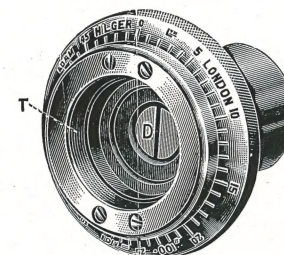


Fig. D 41a

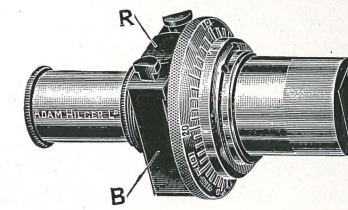


Fig. D 41b

The symmetrical slits supplied on these instruments and on the infra-red spectrometer are shown in Figs. D 41a and D 41b.

Slit D 41a, for the collimator, is provided with a screw-thread T in front of the slit, into which is screwed a diaphragm of 11 mm. aperture. If it be desired to utilise the entire length of the slit (20 mm.) this diaphragm can be removed. The screw thread forms a ready means of adapting an eyepiece to the slit, an arrangement which is often convenient.

Slit D 41b for the telescope differs from slit D 41a only in having a block B with recess R for thermopile, and an eyepiece for observation of the slit and thermopile. This block is no hindrance to the use of the slit for the monochromatic illuminator.

Both the above slits are adjustable by large milled ring, with division reading to 1-1000 inch.

D 41.—Large Aperture Quartz Wavelength Spectrometer and Monochromatic Illuminator for the ultra-violet.

See p. D 7 for accessories to convert this instrument to an Infra-Red Spectrometer.

BARFIT QUARTZ MONOCHROMATOR AND WAVELENGTH SPECTROMETER

This instrument, while it is complete in itself, forms a part of the range of instruments constituted by the Barfit Constant Deviation Wavelength Spectrometer and its coordinated accessories, which are fully described in our Catalogue S.B.241.

The monochromator, which is supported on a solid pillar (with base specially designed to fit the Standard Hilger Accessory Bar) consists of collimator and telescope mirror systems and a quartz prism dispersing system of the modified Wadsworth type (see footnote on page D 12).

The symmetrical slits are of the same type as those fitted to the Large Quartz Wavelength Spectrometer D 41 (see above).

* See note (*) on p. D 12.

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The collimator and telescope mirrors have an aperture of 38 mms. and focal length of 27 cms. They are rigidly attached to the baseplate.

The 60° quartz prism is of the Cornu form, 32 mm. high and 42 mm. length of face. The prism and a plane mirror are mounted on a prism table rotated by a fine screw motion controlled by a drum, bearing a helical scale of wavelengths which can be read to an average accuracy of 3 Å throughout the range (1850 Å to 9000 Å).

A metal cover encloses the whole space between slits and completely excludes stray light.

This instrument, in common with other Barfit instruments has a base so designed that it may be attached directly to a Standard Hilger Accessory Bar.

D 222.—Complete Barfit Quartz Monochromator and Ultra-violet Wavelength Spectrometer as described above.

E 481.—Standard Hilger Accessory Bar.

See p. D 7 for accessories to convert this instrument to an Infra-Red Spectrometer.

ACCESSORIES

F 278.—Quartz Condenser, corrected for spherical aberration, on raising and lowering stand.

F 43/4.—Fluorescent Eyepiece with bright pointer by means of which the ultra-violet lines can be seen as far as the 1850 Å aluminium group thus converting the instrument into a wavelength spectrometer for the ultra-violet.

D 104.—Camera for use with the Large Quartz Wavelength Spectrometer (D 41), fitting in place of the telescope of the spectrometer. It is provided with the necessary focussing and tilt adjustments to enable the complete spectrum down to 2000 Å to be photographed in three exposures on a plate $4\frac{1}{4} \times 3\frac{1}{4}$ ins. ($\frac{1}{4}$ plate). Total length of spectrum about 9 ins. The body of the camera and the dark slide are constructed of selected, highly polished mahogany.

D 203.—Camera for use with D 222 Barfit Quartz Monochromator. This fits in place of the telescope mirror of the spectrometer and is provided with the necessary adjustments to enable the complete spectrum down to 1850 Å to be photographed in two exposures on a plate $4\frac{1}{4} \times 3\frac{1}{4}$ ins. ($\frac{1}{4}$ plate). Total length of spectrum about 5.1 inches. The body of the camera and the plate holder are constructed of selected highly polished mahogany.

F 110.—Sensitive Linear Thermopile for quantitative measurements in the visible, and in the ultra-violet up to 2378 Å (*see* description in Catalogue F on pp. F 37 to F 39). For suitable galvanometers *see* pp. D 14-15.

F 609.—Sodium Photo-electric Cell with Quartz Window. For full particulars of photo-electric cells and their application to Hilger Spectrometers *see* the booklet "Photo-electric Cells" (Hilger Publication No. 124).

F 617.—Light-tight Case for above cell. Suitable for use with these or other spectrometers.

F 333.—Cell of fused silica (not optically worked), fitting the recess on the exit slit of the D 41 or D 222 Monochromatic Illuminator for experiments on photo-chemistry. This cell will fit also the D 88 or D 223 Infra-red Spectrometers.

SMALLER APERTURE QUARTZ WAVELENGTH SPECTROMETER

Note.—The smaller model formerly listed under catalogue number D 33 is now replaced by D 222 in the **BARFIT** Wavelength Spectrometer Outfits; *see* Hilger Publication No. 241 and pp. D 5-6 of this Catalogue. At the time of publication of this catalogue there are, however, still a few of the D 33 type instruments available; subject to prior sale they are offered at the current list price.

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ADDITIONS FOR CONVERTING THE ULTRA-VIOLET QUARTZ SPECTROMETER AND MONOCHROMATIC ILLUMINATORS INTO THE INFRA-RED SPECTROMETER DESCRIBED ON pp. D 11-13

FOR LARGE APERTURE MODEL D 41

An order for the following additions not accompanied by a monochromator must include the number (or the date of delivery) of the instrument with which they are to be used.

Consisting of concave mirrors of stainless steel, plane mirror to replace that used for the ultra-violet, thermopile to fit into slit D 33b above, cast-iron base and mounting for the symmetrical slits and mirrors, and case to take the ultra-violet or infra-red portions of the apparatus when not in use.

When it is desired to use the apparatus for infra-red work, it is only necessary to remove the telescope and collimator, to replace the quartz prism by that for the infra-red (mentioned separately below), and to attach the cast-iron frame on which the mirrors and symmetrical slits are mounted.

These additions are as described above, of dimensions to correspond with the aperture of the D 88 type of Infra-Red Spectrometer.

D 105.—Additions to convert the D 41 Large-Aperture (F/4.5) Quartz Wavelength Spectrometer and Monochromatic Illuminator into the Large Aperture Infra-Red Spectrometer, Basic Instrument, D 88 (without prism, drum, etc. *See* pp. D 11-13):

D 208.—Drum, calibrated in wavelengths for the infra-red for use with quartz prism of D 41.

D 90.—Fluorspar prism, mount and drum, calibrated in wavelengths for the infra-red.

D 91.—Rocksalt prism, mount and drum, calibrated in wavelengths for the infra-red.

D 92.—Sylvine prism, mount and drum, calibrated in wavelengths for the infra-red.

FOR BARFIT MODEL D 222

The optical trains, except for the prisms and mountings of the Barfit Quartz Monochromator and the Barfit Infra-Red Spectrometer, are identical. To convert from one to the other only requires the addition of a thermopile and the substitution of the appropriate prism and wavelength calibrated drum, as follows.

F 110.—Sensitive Linear Thermopile, sensitive area 10×0.5 mm.

D 204.—Calibrated Drum and Prism Mount for the infra-red for use with quartz prism of D 222.

D 171.—Fluorspar Prism, Prism Mount, and Calibrated Drum.

D 172.—Rocksalt Prism, Prism Mount, and Calibrated Drum.

D 173.—Sylvine Prism, Prism Mount, and Calibrated Drum.

*For suitable galvanometers for use with the above infra-red attachments, *see* pp. D 14-15.*

BARFIT DOUBLE QUARTZ MONOCHROMATOR

The Barfit Quartz Monochromator (D 222) is readily converted to a Double Monochromator by mounting upon the Hilger Standard Accessory Bar with it a similar unit (D 205) of slightly modified design. The collimator (entrance) slit of the D 222 Monochromator serves also as the telescope (exit) slit of the D 205 preliminary unit. The adjusting drums are coupled to a single control mounted on the base of the instruments.

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The use of mirrors in place of lenses ensures achromatism at all wavelengths without need of adjustment.

For all applications in which a small admixture of stray light may cause disproportionate errors of measurement, e.g. with a photo-cell used at a wavelength remote from its peak of sensitivity, the use of a double monochromator is strongly recommended.

Further details will be found in Catalogue S.B.241.

The instrument consists of:

D 222. Barfit Quartz Monochromator (see pages D 5-6).

E 481.—Standard Hilger Accessory Bar.

D 205.—Additional Monochromator Unit without slit or prism.

D 178.—Quartz Prism, Mount and Calibrated Drum for D 205.

F 111.—Symmetrical Slit for collimator of D 205.

VERY FAST SPECTROGRAPH (F/1.8)

USABLE ALSO AS LARGE APERTURE MONOCHROMATOR

This instrument is a variable adjustment spectrograph of great light-gathering power, high definition and high dispersion for this relative aperture and is usable also as a monochromator of large output, the wavelength range being $\cdot 19\mu$ to $1\cdot 2\mu$. It is a single prism instrument employing a Cornu prism of crystalline quartz of

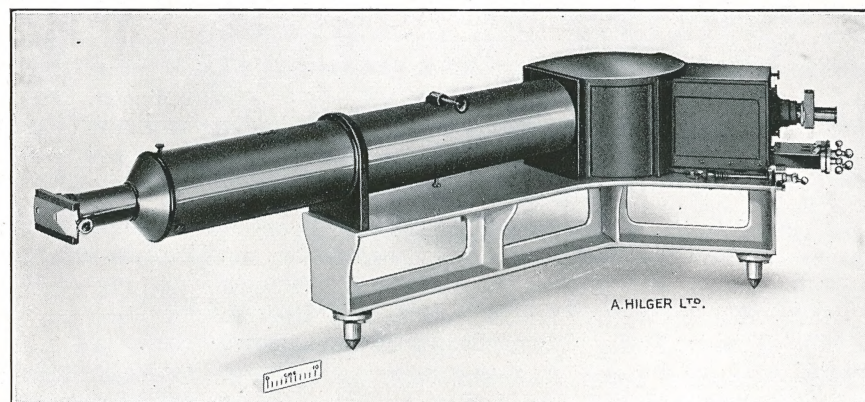


Fig. D 96

exceptional dimensions, viz. 17.8 cm. face length \times 11.4 cm. high (7 \times 4.5 inches). As a part of the spectrum is photographed at a time, the prism is provided with automatic adjustment for minimum deviation for the camera axis. The instrument is very suitable for use in the investigation of faint or transient light sources.

The camera objective has an aperture 11.4 cm. diameter and relative aperture varying from F/1.6 at $\cdot 19\mu$, to F/2.0 at $1\cdot 2\mu$. By a special optical design the objective is corrected for the full aperture for all wavelengths and first quality definition is obtained.

A special, long slit of length 40 mm. is used. It has a stepped reducing wedge so that the spectrum lines are square-ended instead of inclined as with the usual tapered reducing wedges. By this means the slit length may be reduced by steps of 5 mm. down to 10 mm.

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A linear thermopile, of special design, in an air-tight chamber with one low-power eyepiece is supplied for use with the instrument as monochromator in quantitative radiometric work. Provision for an alternative form of thermopile may be made by arrangement. The whole instrument is totally enclosed and mounted on a substantial and rigid cast-iron base, the mechanical construction being all of metal and the workmanship first quality throughout.

For fuller particulars see descriptive leaflet, Hilger Publication No. 134, free on application, and J. W. Perry, *Trans. Opt. Soc.*, 33, 159 (1931-32), reprint free on application.

The camera for use in the spectrograph is supplied separately, see below, and takes plates $3\frac{1}{4} \times 2\frac{1}{8}$ inches.

D 96.—F/1.8 Quartz Spectrograph arranged as Monochromator.

D 101.—Camera Attachment to D 96 for F/1.8 Quartz Spectrograph.

LARGE OUTPUT DOUBLE AND SINGLE MONOCHROMATORS WITH GLASS OR QUARTZ OPTICAL WORK

These instruments are of a new design. They have been designed as large-output monochromators capable of providing light of high purity for irradiation and similar purposes, not necessarily with high definition. They may be converted, if desired, to a quartz or glass spectrograph of medium size and high definition, taking a plate 10 \times 4 inches in dimensions. This distinguishes these instruments as high-output monochromators from those not capable of such conversion.

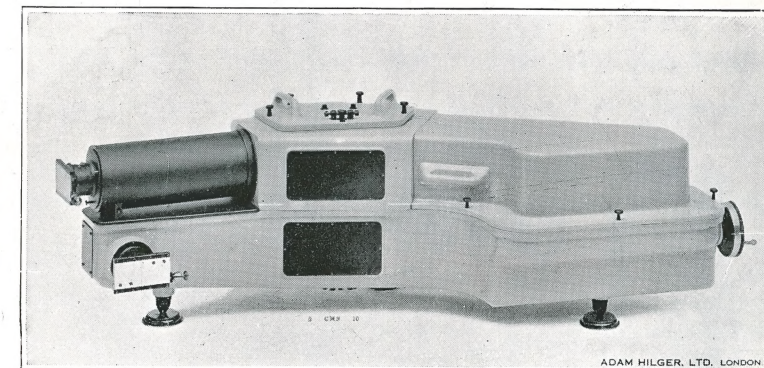


Fig. D 174

The optical system of the single monochromator consists of a collimator, prism and rotating lens with exit slit carried on a rotating arm with provision thereon for thermopile or other mountings. The double instrument consists of two systems, one above the other, the light being conducted from the upper to the lower system by reflecting prisms and through an intermediate slit the exit slit being stationary. The wavelength adjustment is controlled by a divided drum and screw. The whole instrument is enclosed within a massive casting and is in permanent adjustment.

The essential dimensions of these instruments are approximately as follows:

Prisms: height 11.7 cm.

face length 13.0 cm.

Lenses: Aperture 12.7 cm. diameter.

Mean focal length 56 cm.

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The slits are of a special design of length 40 mm., opening symmetrically.

The range of the instrument with quartz optical work extends from 0.2μ to 1.0μ , and with glass optical work from 0.365μ to 1.0μ .

The spectrum length obtained when the instrument is used as a spectrograph is 185 mm. from 2100 Å to 6000 Å, sharp definition being obtained over the whole length in one exposure.

Fuller description on application: *see also* J. W. Perry, *Proc. Phys. Soc.* 50, 265, 1938, reprint free on application, and Schneider, Goodeve and Lythgoe, *Proc. Roy. Soc., A.* 170, 103 (1939).

CATALOGUE NUMBERS

D 174.—Large Output Double Monochromator, Quartz.

D 211.—Large Output Double Monochromator, Glass.

D 212.—Large Output Single Monochromator, Quartz.

D 213.—Large Output Single Monochromator, Glass.

D 175.—Quartz Spectrograph Parts for D 174, D 211, D 212 or D 213 Monochromators.

D 214.—Glass Spectrograph Parts for D 174, D 211, D 212 or D 213 Monochromators.

MONOCHROMATORS—VISIBLE REGION

(N.B.—Several of the foregoing Monochromators are of use in the visible region).

BARFIT WAVELENGTH SPECTROMETER-MONOCHROMATOR

An efficient monochromator for the visible part of the spectrum consists of the ordinary Barfit Wavelength Spectrometer (D 186 or D 187) fitted with symmetrical entrance and exit slits in place of the normal unilateral slit and shutter eyepiece. For further details *see* Catalogue S.B.241.

D 186 (or D 187).—Barfit Wavelength Spectrometer.

F 111.—Symmetrical Slit for Collimator.

F 82.—Symmetrical Slit with eyepiece for Telescope.

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INFRA-RED SPECTROMETERS

LARGE APERTURE INFRA-RED SPECTROMETER

CALIBRATED IN WAVELENGTHS

The Müller-Hilger UVISIR Double Spectrometer-Monochromator, *see* p. D 2, also forms a large-aperture, accurate infra-red spectrometer of high dispersion.

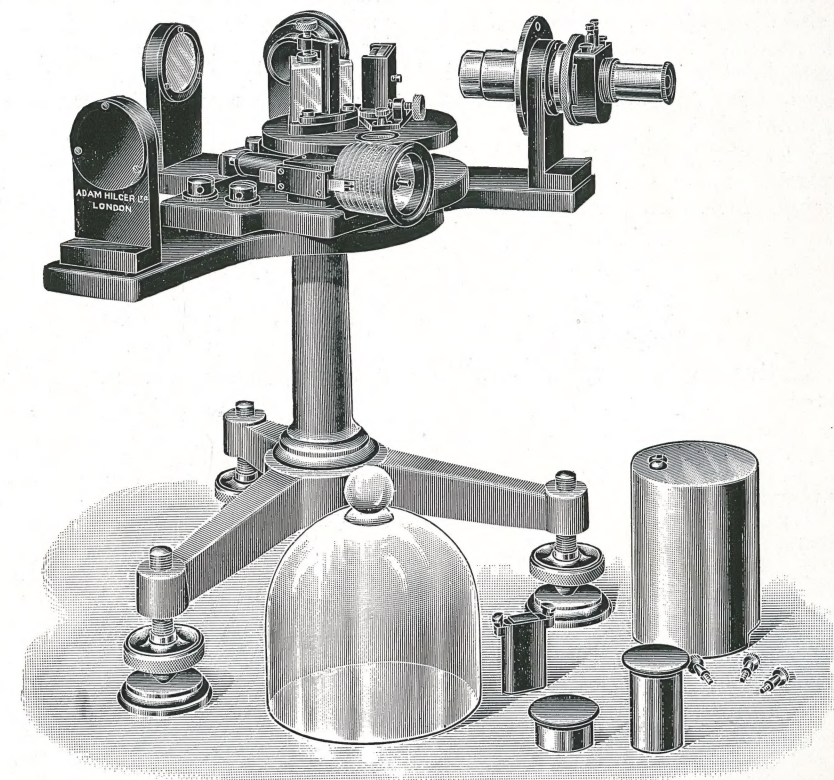


Fig. D 88/89

The optical elements of the Infra-red Spectrometer, which is in general similar to Fig. D 88/89 are as follows:

Two symmetrical slits, each having an effective length of jaws of 20 mm. In the second of these slits is mounted a Hilger thermopile sensitive area 10×0.5 mms. (fully described in Catalogue F).

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Two concave mirrors of stainless steel, both of 23 cms. focal length and 50 mm. diameter.

Prism 45 mm. high, 74 mm. length of face. Plane mirror, stainless steel.

The two slits and the two concave mirrors are rigidly fixed to a cast-iron base.

Levelling screws are supplied to the tripod.

The light entering from the first slit is collimated by the first mirror, and passes through the prism to the plane mirror. It is reflected thence to the second concave mirror, by which an image of the spectrum is formed on the second slit.*

The prism and plane mirror are mounted on a table which is capable of rotation by a fine screw. To this screw is attached a drum on which the wavelength of the line under observation is read direct by means of an index running in a helical slot in the same way as in the case of the Wavelength Spectrometer.

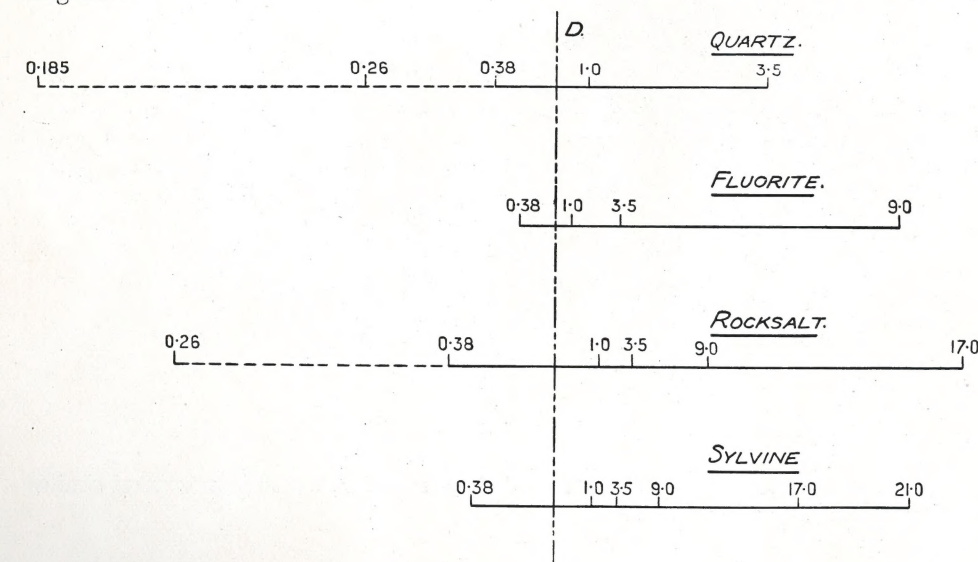
The entire thermopile mount is protected from external radiations by a large nickel-plated case.

The thermopile will be supplied with a sensitive area 10 mm. long \times 0.5 mm. wide unless otherwise ordered. If desired the 20 mm. long \times 1.5 mm. wide size can be supplied at an increase of price. The larger size gives, of course, larger galvanometer deflections (provided the whole length of the slit be filled with light), but owing to the curvature of the spectrum lines a less accurate reading of the wavelength is obtainable.

We can now supply for use with the instrument as described above prisms of four dispersing media together with corresponding wavelength drums. The ranges of wavelength for which the calibration is made are as follows:—

Prism.	Range of calibration.
Quartz.	0.38 μ to 3.5 μ
Fluorite.	0.38 μ to 9 μ
Rocksalt.	0.38 μ to 16 μ
Sylvine.	0.38 μ to 21 μ

The relative lengths of spectrum within these ranges are shown in the following diagram:—



* An arrangement, in which every ray when in the position of observation passes through the prism at minimum deviation, was first used by Wadsworth, *Phil. Mag.* (5), 38, 346 (1894). The arrangement used on the Hilger Infra-red Spectrometer differs however from that of Wadsworth in that the mirror is differently orientated relative to the 60° prism.

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It will be seen that, in selecting prisms, attention should be paid to dispersion required as well as to range of transparency. (The dotted lines in the figure show the dispersion of quartz and rocksalt in the ultra-violet.)

The Quartz prisms are of the Cornu type, consisting of two halves of opposite rotation which are united in optical contact.

The Fluorspar prism is built up from smaller selected pieces cemented with a special cement which enables the best optical definition to be obtained. The radiation does not pass through the cement but parallel to it.

The Rocksalt (NaCl) prism is varnished with a solution of pyroxylin in amyl acetate unless special instructions are given to the contrary. This varnish, while protecting the prism, allows most of the infra-red rays in the region over which this spectrometer is calibrated to pass almost unabsorbed. It is stated to have one strongly-marked absorption band, but if necessary it can easily be washed off with amyl acetate.

The Sylvine is an artificial material made for us by Professor Pohl of Göttingen University. We have tested this material for transmission up to 20 μ and also for refractive index and find that within the limits of our experiment it has dispersion as found for the natural crystal by Professor Paschen (*Ann. d. Physik*, 26, p. 136, 1908).

D 88.—Infra-red Spectrometer, Basic instrument without prism, prism mount and calibrated drum.

D 89.—Quartz prism, prism mount and calibrated drum.

D 90.—Fluorspar prism, prism mount and calibrated drum.

D 91.—Rocksalt prism, prism mount and calibrated drum.

D 92.—Sylvine prism, prism mount and calibrated drum.

See p. D 15 for accessories to convert this instrument to an Ultra-Violet Monochromator.

BARFIT INFRA-RED SPECTROMETER

This instrument, like the Barfit Quartz Monochromator (see pages D 5-6) is complete in itself although it forms part of a series of instruments based upon the Hilger Barfit Wavelength Spectrometer and is capable of conversion to other forms of spectrometer.

Its optical system is identical with that of the D 222 Barfit Quartz Monochromator (see page D 5); it includes a sensitive linear thermopile but not a prism and calibrated drum. The latter must be chosen from the four kinds available and added to complete the instrument. The relative dispersions and ranges of calibration of these prisms are as indicated in the diagram on page D 12.

Further details of this instrument will be found in Catalogue S.B.241.

D 223.—Barfit Infra-Red Spectrometer, complete except for prism and calibrated drum to be chosen from the following:

D 170.—Quartz Prism, prism mount and drum calibrated from 0.38 to 3.5 μ .

D 171.—Fluorspar Prism, prism mount and drum calibrated from 0.38 to 9 μ .

D 172.—Rocksalt Prism, prism mount and drum calibrated from 0.38 to 17 μ .

D 173.—Sylvine Prism, prism mount and drum calibrated from 0.38 to 21 μ .

E 481.—Standard Hilger Accessory Bar.

See p. D 15 for accessories to convert this instrument to an Ultra-Violet Monochromator.

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WAVELENGTH SPECTROMETER, WITH CALIBRATION EXTENDED TO 2.0μ

For investigations in the infra-red below 2.0μ the Barfit Wavelength Spectrometer can be used when certain accessories have been added. This range is sufficient for many purposes.

The outfit, excluding stands for tubes, galvanometers, etc. (below), is as follows:

- D 187.—Barfit Wavelength Spectrometer with prism of $n_D 1.74$.
- F 1051.—Drum calibrated to 2.0μ .
- F 82.—Symmetrical Slit with thermopile mount for telescope.
- F 111.—Symmetrical Slit for collimator.
- F 86.—Thermopile, sensitive area 20×1.5 mm.
- E 481.—Standard Hilger Accessory Bar.

ACCESSORIES FOR THE FOREGOING INSTRUMENTS

Among the disturbing factors in infra-red work, where sensitive galvanometers such as the Paschen are used, an important one is that of adiabatic compressions. To overcome these Sir R. Robertson and Dr. J. J. Fox (*Roy. Soc. Proc.* 120, p. 143) have designed an air-tight holder for the thermopile. Such a holder can be supplied in place of the customary one for an additional charge.

F 497.—Air-tight Thermopile Mount and Slit with Rocksalt Window, as designed by Sir R. Robertson of Government Laboratory, London, *in place of holder usually supplied, extra.*

F 533.—Air-tight Thermopile Mount and Slit with Rocksalt Window, as F 497 but supplied *in addition* to usual holder, or separately.

F 476.—Concave Stainless Steel Mirror, 9 in. radius of curvature, 2.36 in. (6 cms.), clear aperture, tilting on gymbals and on raising and lowering stand. Suitable for the entire infra-red, visible and ultra-violet.

F 977.—Aluminised Concave Mirror on stand to fit Standard Hilger Accessory Bar (not for use with D 88, etc.).

F 1054.—Change-over Stand for two absorption tubes, on mount to fit Standard Hilger Accessory Bar. This stand is arranged so that two tubes mounted side by side can be quickly interchanged in the optical axis of the apparatus by a simple rocking movement. *Suitable tubes will be quoted for on receipt of particulars of requirements.*

F 1049.—Shutter Attachment for F 1054.—A simple lever operated shutter for attachment to the above change-over stand, by means of which the light entering the infra-red spectrometer may be interrupted at will.

F 91.—Cambridge Moving Magnet Galvanometer. (Made by Cambridge Instrument Co. Limited, Cambridge and London), selected as being suitable for work with this instrument.

F 93.—Scale, on stand with lamp for use with Cambridge Moving Magnet Galvanometer (unshielded pattern) F 91. For 4 volts 8 watts. (Made by Cambridge Instrument Co. Limited, Cambridge and London.)

F 1133.—Transformer for use with Lamp and Scale F 93, reducing A.C. mains voltage to 4 volts. State A.C. mains voltage in ordering.

F 1164.—Lamp and Scale Outfit with built-in Transformer. State A.C. mains voltage when ordering.

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GALVANOMETER RELAY

A photo-electric galvanometer relay has been designed in our laboratories. It offers considerable advantages for work with infra-red spectrometers, since by its use a very high current sensitivity can be obtained with comparative ease.

The deflections of a galvanometer are magnified several hundred times by the use of this device. A comparatively robust galvanometer of a type not readily susceptible to outside disturbances can therefore be connected in the thermopile circuit and, used in conjunction with this relay, the resultant sensitivity is then many times greater than can normally be obtained with even the most sensitive galvanometers.

Particulars of this equipment are given on page F 40 of our Catalogue F.

ADDITIONS TO CONVERT THE INFRA-RED SPECTROMETERS TO QUARTZ WAVELENGTH SPECTROMETER AND MONOCHROMATORS

(As on pages D 11-13)

An order for the following additions not accompanied by an infra-red spectrometer must include the number (or date of delivery) of the instrument with which they are to be used.

FOR LARGE-APERTURE MODEL D 88, Etc.

D 106.—Additions to convert the D 88 Large Model Infra-Red Spectrometer into the Large-Aperture (F/4.5) Quartz Wavelength Spectrometer and Monochromatic Illuminator D 41.

FOR BARFIT INFRA-RED SPECTROMETER

(a) If Infra-red Spectrometer has no quartz prism.

D 178.—Quartz Prism, mount and drum calibrated for the ultra-violet.

(b) If Infra-red Spectrometer already has a quartz prism.

D 224.—Drum and Prism Mount only, as used in D 178.

INFRA-RED PRISM-GRATING SPECTROMETER FOR THE MEASUREMENT OF THE ABSORPTION OF GASES

This instrument has been developed from the type described by Sleator (*Astrophys. J.*, 48, 125-143, 1918) and Imes (*Astrophys. J.*, 50, 251-276, 1919) with modifications and improvements based on the suggestions of Snow and Taylor (*Proc. Roy. Soc. A.*, 124, 442-452, 1929).

Essentially it consists of a grating spectrometer used in train with a monochromator having a large aperture rocksalt prism. The combined instrument is built into a substantial cast metal casing (see Fig. D 79) provided with cover plates for total enclosure of the optical system. The casing may be filled with dry air or any chosen gas, nozzles being provided for this purpose. Care has been exercised in the design

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to ensure that the optical paths shall be as short as is consistent with the requirements of the optical system. Polished stainless steel mirrors are used throughout 1, 6, 8.

A Nernst glower 9 is attached to the instrument. Its radiations pass through either of two absorption tubes, 10, are reflected into the prismatic monochromator and thence pass to the grating spectrometer.

The absorption tubes for gases are each of 2.5 cm. internal diameter and 45 cm. long. They are of brass and have rocksalt end plates, held in place by screw-on end caps. A simple locking device enables them to be interchanged quickly and in correct alignment.

The slits 11, 12, 13 are of the symmetrical type with an accurate differential screw motion (with 100 and 50 threads per inch), controlling the opening of the jaws, which are of stainless steel.

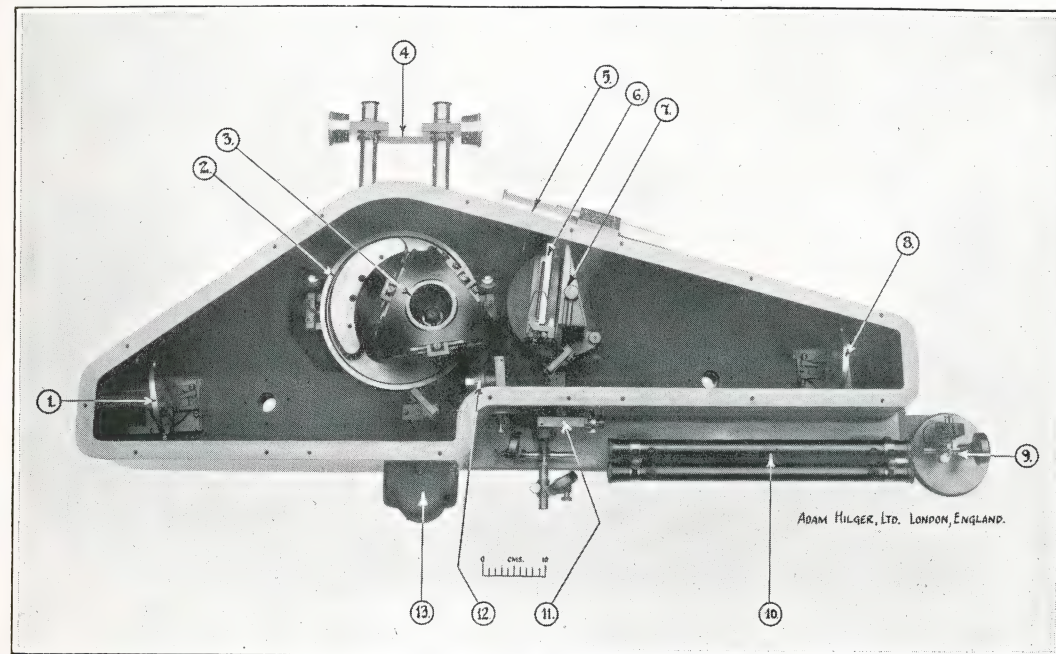


Fig. D 79
Plan view of Infra-Red Prism-Grating Spectrometer, with cover removed.

The rocksalt prism 7 has an aperture of $11\frac{1}{2}$ cm. by $9\frac{1}{2}$ cm. and a refracting angle of 18° . It is fitted in a mount provided with geometrical locating devices, so that it may be removed and replaced without affecting the adjustment. A plane stainless steel mirror 6 is mounted on the prism table, behind the prism, and is provided with a new type of fine adjustment* which permits of very precise control.

A helical drum 5, calibrated directly in wavelengths from 0.38μ to 17μ rotates the prism table by means of an accurate micrometer screw, similar to that used in our D 19 Large Wavelength Spectrometers.

The gratings, of which three alternative rulings may be employed, are mounted in a substantial three-sided turret 3 carried on a finely divided circle. Each grating is fitted with a quickly removable cover protecting it from damage when not in actual use. A handwheel underneath the instrument body and concentric with the coarse adjustment of the circle rotates the grating turret, through suitable gearing, so that

* See British Patent No. 367860/32. J. H. Dowell, *Journ. Sci. Inst.*, 9, No. 7, 1932. *Engineering*, April 1, 1932.

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each grating in turn may be brought into position over the centre of rotation of the circle. A strong spring "detent" indicates the accurate positioning of the grating.

The divided circle is inside the casing, by which it is completely protected, and is read by a pair of external reading microscopes 4 provided with micrometer eyepieces which enable readings of the circle to be made correctly to one second of arc. An external slow motion is provided. The scale is illuminated by two lamps, mounted outside the case to avoid disturbances caused by warmth from them. A series resistance with switch is provided for adjustment of the brightness of the lamps.

The thermopile mounting 13 is of the air-sealed type designed at the Government Laboratory under the direction of Sir Robert Robertson. The thermopile (Hilger standard type F 110) is therefore immune from adiabatic disturbances.

All working adjustments can be made without removing the covers from the instrument.

Two gratings are included in our list price and these are as follows :

- (1) 9 cm. \times 9 cm. ruled area ; ruled with 14,400 lines per inch.
- (2) 9 cm. \times 9 cm. ruled area ; ruled with 2,400 lines per inch.

We can also quote for a third grating of intermediate ruling :

- (3) 9 cm. \times 9 cm. ruled area ; ruled with 7,200 lines per inch.

D 79.—Infra-Red Spectrometer for the measurement of the absorption of gases

AUTOMATICALLY RECORDING INFRA-RED SPECTROMETER

By coupling an infra-red spectrometer with a recording drum the deflections of the galvanometer corresponding with the various portions of the infra-red spectrum may be automatically recorded.

The spectrometer selected for this purpose is our D 88 Large Model Infra-Red Spectrometer (see page D 13) which has been suitably modified to permit its being mounted on a rigid cast-iron bed together with the recording-drum camera to which it is coupled. Any of the optical systems listed with the D 88 instrument may be fitted interchangeably on the present apparatus. The optical system, thermopile, etc., are identical with those of D 88. An airtight housing (F 497) for the thermopile is fitted.

The drum camera stands upon the same base as the spectrometer and is located thereon by guide strips and clamp screws. It is easily uncoupled and removed for loading or unloading in the dark room. A train of gears is embodied in the drum mechanism whereby the complete wavelength range of the spectrometer is recorded in a single rotation of the drum. The driving is performed by an electric motor with suitable speed-reducing gear.

The record is made by light reflected from the galvanometer mirror entering the camera by a slit 4 mms. wide, parallel to the axis of the drum, provided with a hinged cover. A cylindrical lens fitted in the slit focusses the light upon the drum. For calibrating purposes a scale is provided. The drum takes a sheet of bromide paper measuring 12×42 cms. Means are provided for recording reference wavelengths on the paper automatically.

A projector lamp for providing the recording spot is built into the recording apparatus.

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GALVANOMETERS

No galvanometer is provided with this apparatus but the following recommendations are made.

The Cambridge Short-Period Galvanometer is very suitable for recording purposes, in so far as it is robust, has a very stable zero, and a short period (1.8 seconds). Its sensitivity, however, is 300 mms. per micro-amp. at one metre.

The Cambridge Shielded Galvanometer is of the Moving Magnet type and is considerably more sensitive than the above Cambridge Short-Period Galvanometer, as the current required for a deflection of 1 mm. is only about 8×10^{-10} amperes. It is not quite so suitable for recording as is the Cambridge Short-Period on account of its greater period (about 6 seconds) and the less stability of its zero. However, it is satisfactory for this application and its use is essential if the Cambridge Short-Period is considered insufficiently sensitive. It is not affected by external magnetic fields as shields of mu-metal and soft iron are actually built into it.

The Hilger Galvanometer Relay System is readily and usefully employed with the automatically recording spectrometer, using the Cambridge Short-Period Galvanometer as the primary galvanometer. It can increase the effective sensitivity of the Cambridge Short-Period Galvanometer several hundred times. It is not recommended for use with the Cambridge Shielded Galvanometer. *Full particulars of the outfit will be found in Hilger Catalogue F on page F 40.*

CATALOGUE NUMBERS

D 194.—Automatically Recording Infra-Red Spectrometer, Basic Instrument consisting of large infra-red spectrometer coupled to recording drum camera on substantial cast-iron base with projector lamp for galvanometer, but without prisms or calibrated drum.

D 195.—Quartz prism, prism mount and calibrated drum.

D 196.—Fluorspar Prism, mount and calibrated drum.

D 197.—Rocksalt prism, prism mount and calibrated drum.

D 198.—Sylvine prism, prism mount and calibrated drum.

ACCESSORIES

F 476.—Concave Mirror, on raising and lowering stand.

F 966.—Cambridge Short-Period Galvanometer, 25 ohms coil resistance. (Made by the Cambridge Instrument Co., Ltd., London and Cambridge.)

F 967.—Cambridge Shielded Moving Magnet Galvanometer. (Made by the Cambridge Instrument Co., Ltd., London and Cambridge.)

F 93.—Galvanometer Lamp and Scale, 4 volts, 8 watt. (Made by the Cambridge Instrument Co., Ltd., London and Cambridge.)

F 1164.—Galvanometer Lamp and Scale with built-in transformer. State voltage of A.C. mains in ordering. (Made by the Cambridge Instrument Co., Ltd., London and Cambridge.)

(For catalogue numbers and other particulars of the Hilger Photo-electric Galvanometer Relay, see Catalogue F, page F 40.)

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WAVELENGTH SPECTROMETERS

THE HILGER BARFIT WAVELENGTH SPECTROMETER

This is fully described in a 54-page illustrated catalogue (No. S.B.241) which will be sent post free on request. It is so designed that, in conjunction with a carefully co-ordinated range of accessories and interchangeable parts, it can be turned to many uses. In Catalogue S.B.241 these accessories are presented in carefully selected groups according to the several purposes which are to be served.

The following is a very brief summary of the outstanding features of this instrument.

The Prism is of the constant deviation type. Two alternative dispersions are available corresponding to refractive indices of $n_D 1.65$ and $n_D 1.74$. The prisms are provided with interchangeable mounts.

The Wavelength Drums are in the form of calibrated helical scales on sleeves which are interchangeable upon a cylinder attached to the micrometer screw which turns the prism table. Appropriate calibrated sleeves for various dispersing media can be supplied at any time.

The Telescope and Collimator are demountable and means are provided that ensure their accurate alignment on reassembly.

The Eyepiece is the latest type of our shutter eyepiece with bright pointer and filters for illuminating it with light approximating in wavelength to the parts of spectrum in which parallax due to colour is most noticeable. The shutters are simultaneously adjusted by a screw.

The Slit is our standard F 758, with comparison prism and combined wedge and three aperture diaphragm.

A Cover of metal forms a light-excluding connection between telescope and collimator.

The Stand and Bar for Accessories. The stand is so designed that it is easily fitted to the Standard Hilger Accessory Bar. This enables accessories to be set at once in alignment with the main instrument and ensures their remaining in position as long as desired.

D 186.—Hilger Barfit Constant Deviation Wavelength Spectrometer with prism of $n_D 1.65$ and drum calibrated from 3900 A to 9000 A.

D 187.—Hilger Barfit Constant Deviation Wavelength Spectrometer with prism of $n_D 1.74$ and drum calibrated from 3900 A to 9000 A.

Either of the above may be converted to the other or to a grating instrument by the addition of one or other of the following:

D 180.—Constant Deviation Prism $n_D 1.65$ and calibrated drum to interchange with prism and drum of D 187 including case.

D 221.—Constant Deviation Prism $n_D 1.74$ and calibrated drum to interchange with prism and drum of D 186.

D 12.—Replica Grating on right-angle Prism, with mount and calibrated drum interchangeable with any of the above, including case.

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ACCESSORIES

The following is a selection from the accessories usually associated with the instrument and coming within the scope of this catalogue. For full details see our Catalogue S.B.241.

D 72.—Camera. All metal, to fit in place of extension tube with eyepiece of D 186 or D 187. Focussing motion of telescope objective is also used for focussing camera. Takes plates $4\frac{1}{4} \times 3\frac{1}{4}$ ins. and has rack and pinion raising and lowering motion to dark slide so that several spectra can be taken on one plate. Length of spectrum with D 186 from 4060 to 6100 Å, 31 mms.; with D 187, 60 mms. Range of spectrum with D 186, 3650 to photographic limit in infra-red; with D 187 from 3850. Complete with focussing screen and three single metal dark slides (plateholders).

F 519.—Extra High Power Eyepiece with zero adjusting cross-webs.

E 481.—Standard Hilger Accessory Bar.

For arc lamps, condensing lens, etc., see S.B.241 or Catalogue F.

D 167.—Illuminator for Wavelength Drum, with magnifier and control unit for dimming the light; to be connected to the mains.

Parts for Converting the Barfit Wavelength Spectrometer to a Monochromatic Illuminator.

Visual Range (see also page D 10).

F 111.—Symmetrical Slit for collimator.

F 82.—Symmetrical Slit for telescope.

Alternatively

F 758.—Unilateral Slit as fitted to collimator of D 186 or D 187 to replace eyepiece.

Ultra-Violet Range (see also pages D 5-6 for complete instrument).

Single Monochromator.

D 182.—Adaptor with collimator and telescope mirrors, adjustable aluminised mirror, cover, and wooden case.

D 178.—Quartz Prism, mount and calibrated drum.

F 111.—Symmetrical Slit for collimator.

F 82.—Symmetrical Slit for telescope.

D 203.—Camera (for details see page D 6).

D 224.—Calibrated Drum and Prism Mount only, for converting infra-red spectrometer (see page D 15) with Quartz Prism D 170 into ultra-violet monochromator.

Double Monochromator.

Set of parts as above for Single Monochromator. D 187, D 182, D 178, F 111, F 82, together with the following:—

E 481.—Standard Hilger Accessory Bar.

D 205.—Additional Monochromator Unit consisting of stand to fit accessory bar, prism table and slow motion mirrors in mounts, cover, control wheel with connecting belts for wavelength drums and belt rim for drum of D 222 (or alternative equivalent).

D 178.—Quartz Prism, mount and calibrated drum.

F 111.—Symmetrical Slit for collimator.

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Parts for Converting the Barfit Wavelength Spectrometer into an Infra-Red Spectrometer.

With glass prism (see also page D 14).

To an ordinary D 186 or D 187 Spectrometer add:

F 111.—Symmetrical Slit for collimator.

F 82.—Symmetrical Slit for telescope, with mount for thermopile.

F 86.—Thermopile, sensitive area 20×1.5 mm.

F 1050.—Drum calibrated to 2.0μ for D 186.

or

F 1051.—Drum calibrated to 2.0μ for D 187.

With other prisms (see also page D 13).

D 182.—Adaptor with collimator and telescope mirrors, adjustable aluminised mirror, cover and wooden case (as used for monochromator).

F 111.—Symmetrical Slit for collimator (as used for monochromator).

F 82.—Symmetrical Slit with thermopile mount for telescope (as used for monochromator).

F 110.—Sensitive Linear Thermopile, area 10×0.5 mm.

D 170.—Quartz Prism, prism mount and calibrated drum.

D 171.—Fluorspar Prism, prism mount and calibrated drum.

D 172.—Rocksalt Prism, prism mount and calibrated drum.

D 173.—Sylvine Prism, prism mount and calibrated drum.

D 204.—Calibrated Drum and Prism Mount only, for use with Quartz Prism of U.V. Monochromator in the infra-red region.

Camera for Raman Effect Investigations.

D 94.—Camera with 6-in. focus lens, for plates $3\frac{1}{2} \times 2\frac{1}{2}$ ins. The larger relative aperture and smaller dispersion of this camera make it more suitable for recording the spectra of faint sources than is the D 72 model.

For High Resolving Power investigations with etalons, echelons or Lummer-Gehrke plates the Barfit Wavelength Spectrometer can be fitted with a special mount to accommodate such accessories. This mount is provided with a base which fits the Standard Hilger Accessory Bar. For details of this and accessories for use with it see Catalogue S.B.241.

B 339.—Extension Mount for Collimator and high resolving power accessories.

Spare Parts of Barfit Wavelength Spectrometers and separate units.

D 206.—Unit Stand consisting of base and pillar to fit Accessory Bar, prism table and slow motion only.

D 217.—Telescope, as used on D 186 and D 187, complete with object glass, shutter eyepiece, focussing adjustment and clamping screw.

D 219.—Collimator, as used on D 186 and D 187, complete with object glass, adjustable slit and clamping screw, focussed for parallel light.

D 220.—Cover for prism table.

D 221.—Constant Deviation Prism $n_D 1.74$, in mount, with calibrated drum and case.

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D 180.—Constant Deviation Prism n_D 1.65, in mount, with calibrated drum and case.

D 184.—Adaptor for Telescope or Collimator. In conjunction with the Carriage F 1033 (below) this allows either the collimator or the telescope of the Barfit Wavelength Spectrometer to be used as an independent unit on the E 481 Accessory Bar.

F 1033.—Carriage for the bar, consisting of base to fit bar with vertically sliding adjustable rod.

D 169.—Right-angle Prism for D 186 or D 187 to take place of constant deviation prism when photometric and similar observations with full radiation of source are desired.

LARGE MODEL HILGER WAVELENGTH SPECTROMETER

CONSTANT DEVIATION TYPE

The Large Model constant deviation wavelength spectrometer (see Fig. D 19) is constructed on similar principles to those of the former Standard Model wavelength spectrometers but it is of increased size and in every way is more powerful. It is not provided with a BARFIT bar. Its achromatic object glasses are of $1\frac{5}{8}$ inch ($41\frac{1}{2}$ mm.) clear aperture and focal length $14\frac{1}{2}$ inches (368 mm.). The dimensions of the prism and lenses are such that the resolving power obtained justifies the use of very high power eyepieces. The definition obtained will withstand the most searching test.

The dispersing system is a large constant deviation prism of glass having a refractive index for D of 1.65. This glass has been chosen because of its transparency and contributes to the high luminosity of the spectra seen with this instrument, a feature of some importance when the sources to be examined, or individual lines in their spectra, are of feeble intensity.

The wavelength drum is of generous dimensions and its helical scale, engraved directly in angstroms, is about 81 inches (205 cm.) in total length. The scale is therefore open and clearly legible, while an average accuracy of 1 angstrom is obtainable in observation.

The slit is our F 31 type with stainless steel jaws, and a comparison prism (see Catalogue F).

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The eyepiece fitted is of the shutter type (see F 40, Catalogue F, page F 8) with a bright pointer. The shutters can be arranged to obscure all but a selected portion of the field so that comparatively feeble spectral lines shall not be rendered unobservable by the "glare" from neighbouring lines of much greater intensity. The bright pointer is illuminated by a mirror attached to the eyepiece and enables measurement to be carried out when the background of the field of view is quite dark. The pointer can be adjusted laterally by a screw motion.

In order to avoid stray light, and adequately protect the prism, a cast aluminium cover is fitted to the instrument. By undoing two screws it is readily removable for adjustment and inspection of the prism.

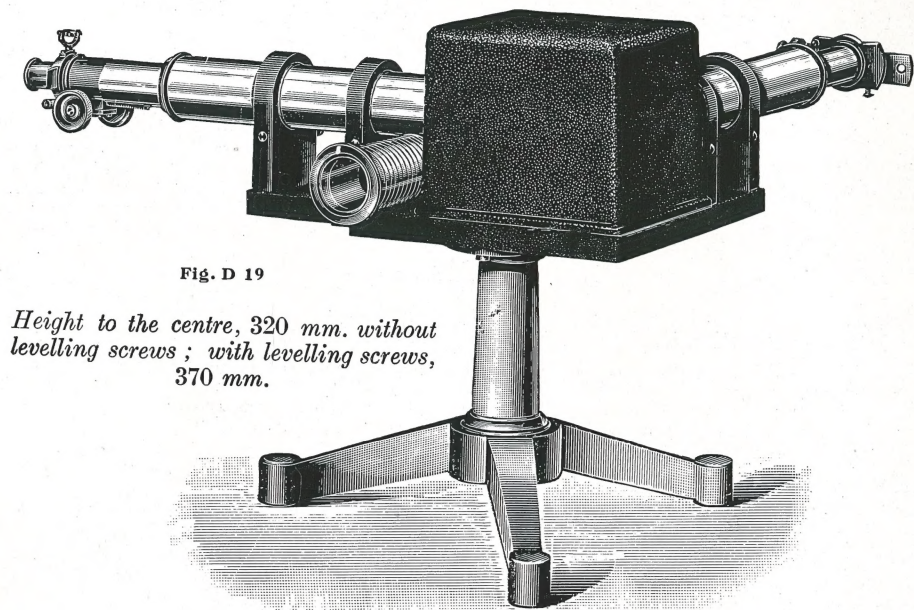


Fig. D 19

Height to the centre, 320 mm. without levelling screws; with levelling screws, 370 mm.

The instrument can readily be used for photography of the visible spectrum by substituting for the telescope a camera having an objective of $21\frac{1}{2}$ inches focal length. This camera is well made, of selected, well-seasoned mahogany, and is provided with a single dark slide for plates $4\frac{1}{4}$ ins. \times $3\frac{1}{4}$ ins. A rack and pinion motion, with a scale and index, allows of several spectra being taken on the one plate.

D 19.—Large Model Wavelength Spectrometer, including shutter eyepiece with bright pointer and lateral adjustment and calibrated complete.

D 21.—Levelling screws to the above.

D 22.—Well-made mahogany case with lock and key.

D 23.—Camera, with $21\frac{1}{2}$ -inch focus lens, to fit in place of the telescope.

For further accessories, see Catalogue F, "Accessories for Spectrometers and Spectrographs."

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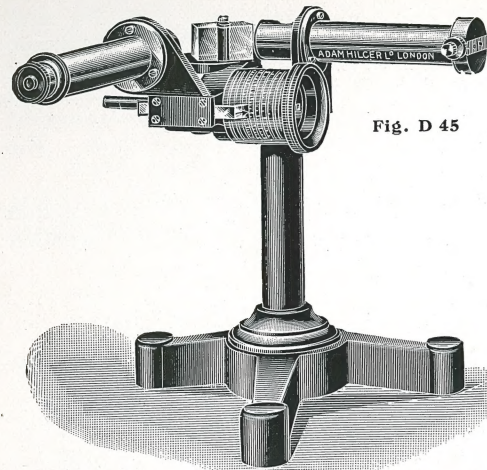


Fig. D 45

SMALL MODEL HILGER WAVELENGTH SPECTROMETER CONSTANT DEVIATION TYPE

This spectrometer is precisely similar in principle to the Hilger Constant Deviation Wavelength Spectrometer. Although of simpler construction, smaller size and of commensurately lower resolving power than the latter instrument, it is accurately made, with a high quality micrometer screw motion with a drum (reading in wavelengths direct) identical with that of the larger instrument.

This instrument cannot be fitted with a camera.

The object glasses are of $4\frac{3}{4}$ inches (120 mm.) focal length and 0.7 inch (17 mm.) clear aperture; and the eyepiece being of 0.4 inch (10 mm.) equivalent focal length, the sodium lines are distinctly separated, even with the lighter prism. A sliding draw tube focusses the telescope.

D 45.—Students' Wavelength Spectrometer, Fig. D 45, prism of 1.62 refractive index for D.

D 50.—Students' Wavelength Spectrometer, with denser prism, 1.74 refractive index for D, and correspondingly increased accuracy of calibration.

D 46.—Protective Cover to prism table for either type.

THE HILGER "FLAME" WAVELENGTH SPECTROMETER

The spectrometer whose dispersive system consists of one 60° prism, from the second surface of which is reflected a photographic scale, dates back to the time of Kirchhoff and Bunsen. It is still the best type of instrument for the examination of flame spectra.

The "Flame" wavelength spectrometer is of this kind, small and portable, strong and not easily put out of adjustment, with a fine and accurate scale reading in wavelengths direct.

It is an ideal instrument, not only for chemical students' first instruction in spectrum analysis, but for expert use whenever simple spectra are concerned. The focal length of the object glasses is 120 mm. and their aperture 17 mm. The dispersion at the focal plane of the telescope is about 5.35 mm. (C to G). The scale covers the range of wavelengths 3850 Å to 8000 Å.

It is made in two forms, D 48 in which the telescope is horizontal, and D 49 in which the collimator, telescope and photoscale tube all lie in a vertical plane, the telescope sloping downward at a convenient angle for reading. In the latter form it is convenient to read by an observer standing and working at a laboratory bench, a mirror being provided for illuminating the scale.

D 48.—Hilger "Flame" Wavelength Spectrometer, horizontal type.

D 49.—Hilger "Flame" Wavelength Spectrometer, vertical type (see Fig. D 49).

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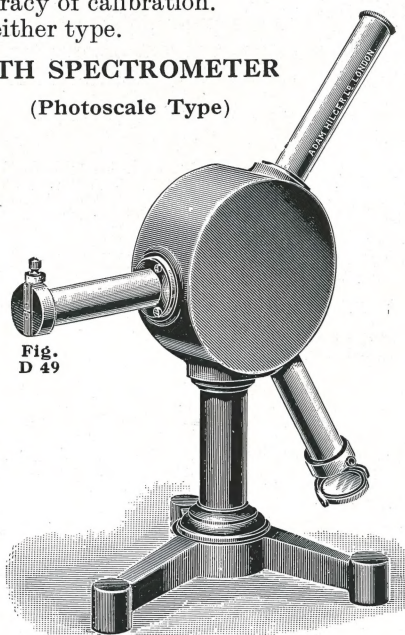


Fig. D 49

(Photoscale Type)

SPECIAL SPECTROSCOPE FOR THE RAPID DETECTION OF NICKEL, CHROMIUM, COBALT, AND OTHER METALS IN STEELS

THE SPEKKER STEELOSCOPE*

See Hilger Publication No. 243

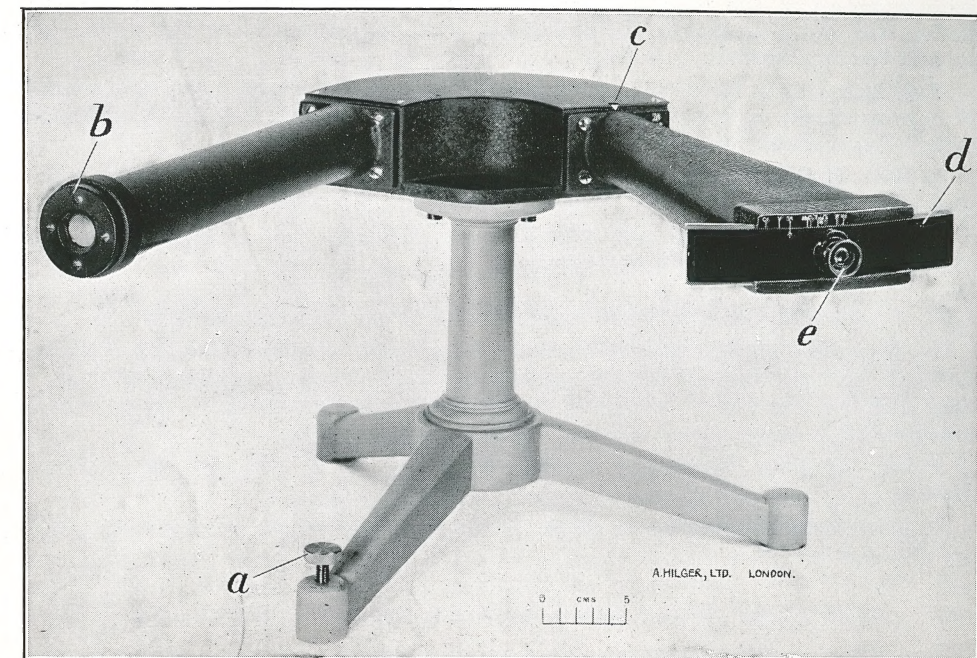


Fig. D 103

A special type of spectroscope known as the Spekker Steeloscope has been designed by us for the rapid detection of any of an important range of metals in an alloy still under workshop conditions.

The instrument is substantially built, with a screw focussing sliding eyepiece (e) at the one end, and a glass condensing lens (b) at the other. The adjustment for observation of the distinctive line or lines is effected simply by sliding the eyepiece until an index points to the chemical symbol of the metal to be observed, and any intelligent lad can, after a few hours preliminary observation of a range of samples containing known percentages of the metals in question, state at once whether

* The word "Spekker" is registered as a Trade Mark in Great Britain, Eire, Germany, and Japan. The phrase "Spekker Steeloscope" is registered as a Trade Mark in Great Britain, Germany and U.S.A.

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those metals are present in samples of unknown composition, and approximately in what amounts.

The method of use is very simple. To take as an example the detection of nickel and chromium in bars of mixed kinds of steel.

One bar of carbon steel or pure iron is held in a suitable wooden frame, and the bars to be tested are then placed in position on V-supports one by one as rapidly as possible, connection with the D.C. electric mains being provided through a suitable resistance.

The arc is struck and the observer at the Spekker Steeloscope (having set the sliding eyepiece at the positions marked Ni or Cr) is able immediately to state whether the sample contains an important quantity of nickel or chromium, or not, and the approximate percentage.

Full instructions for use are provided and include key diagrams for the eleven elements as shown on the final pages of the booklet, "Rapid Routine Control of Steels," Hilger Publication No. 243, sent post free on application.

D 103.—Spekker Steeloscope for the detection of Nickel, Chromium, Molybdenum, Manganese, Titanium, Tungsten, Cobalt, Copper, Tin, Cadmium and Vanadium.

The above instruments are mounted on substantial tripod stands and are accompanied by full instructions for use.

STEELSCOPE FOR QUANTITATIVE ESTIMATIONS

By fitting the Steeloscope with an Insta Eyepiece its accuracy can be materially increased. This photometric eyepiece enables the user to employ a visual modification of the Internal Standard method of quantitative spectrochemical analysis. Full particulars of its construction and use will be found in Catalogue S.B. 243.

D 158.—Spekker Steeloscope (similar to D 103) fitted complete with Insta* Eyepiece.

H 207.—Insta Eyepiece ready to be fitted to any Spekker Steeloscope delivered since January 1st, 1932.

ANALYSED STEEL RODS FOR TRAINING OBSERVERS

In order to accustom workers to the use of the Spekker Steeloscope, we can supply sets of several different types of steels, containing known proportions of various elements. For details of analysis, see Catalogue S.B. 243.

F 903.—Analysed Sample Steel Electrodes. Set of four pairs, $\frac{1}{4}$ in. diam. by 6 ins. long

F 654.—Set of 11 samples for detection of Tungsten, Molybdenum, Chromium Cobalt and Vanadium.

F 655.—Set of 3 samples for detection of Titanium.

The spectrum of a steel which contains a high percentage of Cobalt, Molybdenum, Tungsten, or Chromium contains an increased number of lines and some care and experience are needed to pick out the distinctive lines belonging to the other elements present. As an aid in observing the type of spectrum to be expected in such cases we have had prepared, and can supply, rods of the following steel:—

F 653.—Special Steel Samples 175 mm. long \times 5 mm. diam. per pair

IMPORTANT.—All the above Sample Steel Rods are marked on one end only.

F 628.—H.S. Pure Iron Rods $\frac{3}{8}$ in. diameter, 12 ins. long each

* The word "Insta" is registered as a Trade Mark in Great Britain and U.S.A. The instrument embodies U.S.A. Patent No. 1902109.

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REFERENCE BOOKS

A large number of publications and reprints on the subject of Spectrum Analysis, which we can supply, are listed in "A List of Publications concerning Spectrochemical Analysis" (Publication S.B. 125), post free on request.

The following will be found in Catalogue S.B. 242:
D 202. Small Direct Vision Monochromator, for Polarimeters, etc.

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We reserve to ourselves the right to depart from the Catalogue Specifications of our Instruments. We cannot undertake to be bound in detail, either by the illustrations or the printed descriptions.

ADAM HILGER, LTD.

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